

## MAX6070/MAX6071

## Low-Noise, High-Precision Series Voltage References

### General Description

The MAX6070/MAX6071 offer a very low noise and low-drift voltage reference in a small 6-pin SOT23 package. These devices provide a  $1/f$  noise voltage of only  $4.8\mu\text{V}_{\text{P-P}}$  at an output voltage of 2.5V, with a temperature drift of 6ppm/°C (max). The MAX6070/MAX6071 consume  $150\mu\text{A}$  of supply current and can sink and source up to 10mA of load current. The low-drift and low-noise specifications enable enhanced system accuracy, making these devices ideal for high precision industrial applications. The MAX6070 offers a noise filter option for wide-band applications.

The devices are available in a 6-pin SOT23 package and specified over the extended industrial temperature range of  $-40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ .

### Applications

- High-Accuracy Industrial and Process Control
- Precision Instrumentation
- High-Resolution ADCs and DACs
- Precision Current Sources

### Benefits and Features

- 6-Pin SOT23 Package Reduces System Board Space
- Stable Performance Over Temperature and Time Improves System Accuracy
  - High  $\pm 0.04\%$  Initial Accuracy
  - Low 1.5ppm/°C (typ), 6ppm/°C (max) Temperature Drift
  - Low  $4.8\mu\text{V}_{\text{P-P}}$  Noise (0.1Hz to 10Hz) at 2.5V
  - Low 200mV Dropout Voltage
  - High 85dB Ripple Rejection
- Low  $150\mu\text{A}$  Supply Current Reduces Power Consumption
- Filter Option Lowers High-Frequency Noise
- Output Options: 1.25V, 1.8V, 2.048V, 2.5V, 3.0V, 3.3V, 4.096V, and 5.0V Cover Common Voltage Levels for a Wide Variety of Applications

*Ordering Information and Selector Guide appears at end of data sheet.*

### Typical Operating Circuits



**Absolute Maximum Ratings**

OUTF to GNDS, GNDF, GND.....-0.3V to the lower of  
( $V_{IN} + 0.3V$ ), +6V  
OUTS to GNDS, GNDF, GND .....-0.3V to +6V  
IN to GNDS, GNDF, GND .....-0.3V to +6V  
EN to GNDS, GNDF, GND .....-0.3V to +6V  
FILTER to GND.....-0.3V to the lower of  
( $V_{IN} + 0.3V$ ), +6V  
GNDS to GNDF .....-0.3V to +0.3V

Continuous Power Dissipation ( $T_A = +70^\circ\text{C}$ )  
SOT23 (derate 4.3mW/ $^\circ\text{C}$  above  $+70^\circ\text{C}$ ) ..... 347.8mW  
Operating Temperature Range .....  $-40^\circ\text{C}$  to  $+125^\circ\text{C}$   
Junction Temperature .....  $+150^\circ\text{C}$   
Storage Temperature Range.....  $-65^\circ\text{C}$  to  $+150^\circ\text{C}$   
Soldering Temperature (reflow) .....  $+260^\circ\text{C}$   
Lead Temperature (soldering, 10s) .....  $+300^\circ\text{C}$

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**Package Thermal Characteristics (Note 1)**

SOT23

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ).....230 $^\circ\text{C}/\text{W}$ Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ).....76 $^\circ\text{C}/\text{W}$ 

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

**Electrical Characteristics—MAX607\_\_AUT12 ( $V_{OUT} = 1.250V$ )**

( $V_{IN} = +5.0V$ ,  $I_{OUT} = 0mA$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ , unless otherwise noted. Typical values are at  $T_A = +25^\circ\text{C}$ .) (Note 2)

| PARAMETER                                 | SYMBOL      | CONDITIONS                                                                           | MIN                                                       | TYP | MAX   | UNITS                 |
|-------------------------------------------|-------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------|-----|-------|-----------------------|
| <b>OUTPUT</b>                             |             |                                                                                      |                                                           |     |       |                       |
| Output Voltage Accuracy                   |             | MAX6070A/MAX6071A, $T_A = +25^\circ\text{C}$                                         | -0.04                                                     |     | +0.04 | %                     |
|                                           |             | MAX6070B/MAX6071B, $T_A = +25^\circ\text{C}$                                         | -0.08                                                     |     | +0.08 |                       |
| Output Voltage Temperature Drift (Note 3) | $TCV_{OUT}$ | MAX6070A/MAX6071A                                                                    |                                                           | 1.5 | 6     | ppm/ $^\circ\text{C}$ |
|                                           |             | MAX6070B/MAX6071B                                                                    |                                                           | 2.0 | 8     |                       |
| Line Regulation                           |             | Over specified $V_{IN}$ range                                                        | $T_A = +25^\circ\text{C}$<br>$T_A = T_{MIN}$ to $T_{MAX}$ | 13  | 100   | $\mu V/V$             |
|                                           |             |                                                                                      |                                                           |     | 125   |                       |
| Load Regulation                           |             | $0mA < I_{OUT} < 10mA$ , sink                                                        |                                                           | 70  | 150   | $\mu V/mA$            |
|                                           |             | $0mA < I_{OUT} < 10mA$ , source                                                      |                                                           | 100 | 150   |                       |
| Output Current                            | $I_{OUT}$   |                                                                                      | -10                                                       |     | +10   | mA                    |
| Short-Circuit Current                     | $I_{SC}$    | Sourcing to ground                                                                   |                                                           | 25  |       | mA                    |
|                                           |             | Sinking from $V_{IN}$                                                                |                                                           | 25  |       |                       |
| Long-Term Stability                       |             | 1000 hours at $T_A = +25^\circ\text{C}$                                              |                                                           | 35  |       | ppm                   |
| Thermal Hysteresis                        |             | (Note 5)                                                                             |                                                           | 85  |       | ppm                   |
| <b>DYNAMIC CHARACTERISTICS</b>            |             |                                                                                      |                                                           |     |       |                       |
| Noise Voltage                             | $e_{OUT}$   | 1/f noise, 0.1Hz to 10Hz, $C_{OUT} = 0.1\mu F$                                       |                                                           | 3.6 |       | $\mu V_{P-P}$         |
|                                           |             | MAX6071 thermal noise, 10Hz to 10kHz, $C_{OUT} = 0.1\mu F$                           |                                                           | 5.0 |       | $\mu V_{RMS}$         |
|                                           |             | MAX6070 thermal noise, 10Hz to 10kHz, $C_{OUT} = 0.1\mu F$ , $C_{FILTER} = 0.1\mu F$ |                                                           | 2.5 |       |                       |
| Ripple Rejection                          |             | Frequency = 60Hz                                                                     |                                                           | 100 |       | dB                    |

**Electrical Characteristics—MAX607\_\_AUT12 ( $V_{OUT} = 1.250V$ ) (continued)**

(VIN = +5.0V, IOUT = 0mA, COUT = 0.1μF, TA = -40°C to +125°C, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL | CONDITIONS                         | MIN       | TYP       | MAX | UNITS |
|---------------------------------|--------|------------------------------------|-----------|-----------|-----|-------|
| Turn-On Settling Time           | tR     | Settling to 0.01%,<br>COUT = 0.1μF |           | 6         |     | ms    |
|                                 |        | MAX6071                            |           | 20        |     | μs    |
| Enable Settling Time            | tEN    | Settling to 0.01%,<br>COUT = 0.1μF |           | 6         |     | ms    |
|                                 |        | MAX6071                            |           | 60        |     | μs    |
| Capacitive-Load Stability Range |        | IOUT ≤ 10mA                        | 0.1       |           | 10  | μF    |
| <b>INPUT</b>                    |        |                                    |           |           |     |       |
| Supply Voltage                  | VIN    | Guaranteed by line regulation      | 2.7       |           | 5.5 | V     |
| Quiescent Supply Current        | IIN    | TA = +25°C                         |           | 130       | 200 | μA    |
|                                 |        | TA = TMIN to TMAX                  |           |           | 260 |       |
| Shutdown Supply Current         | ISD    |                                    |           |           | 6   | μA    |
| <b>ENABLE</b>                   |        |                                    |           |           |     |       |
| Enable Input Current            | IEN    |                                    | -1        |           | +1  | μA    |
| Enable Logic-High               | VIH    |                                    | 0.7 x VIN |           |     | V     |
| Enable Logic-Low                | VIL    |                                    |           | 0.3 x VIN |     |       |

**Electrical Characteristics—MAX607\_\_AUT18 ( $V_{OUT} = 1.800V$ )**

(VIN = +5.0V, IOUT = 0mA, COUT = 0.1μF, TA = -40°C to +125°C, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

| PARAMETER                                | SYMBOL | CONDITIONS                    | MIN   | TYP | MAX   | UNITS  |
|------------------------------------------|--------|-------------------------------|-------|-----|-------|--------|
| <b>OUTPUT</b>                            |        |                               |       |     |       |        |
| Output Voltage Accuracy                  |        | MAX6070A/MAX6071A, TA = +25°C | -0.04 |     | +0.04 | %      |
|                                          |        | MAX6070B/MAX6071B, TA = +25°C | -0.08 |     | +0.08 |        |
| Output Voltage Temperature Drift(Note 3) | TCVOUT | MAX6070A/MAX6071A             |       | 1.5 | 6     | ppm/°C |
|                                          |        | MAX6070B/MAX6071B             |       | 2.0 | 8     |        |
| Line Regulation                          |        | Over specified VIN range      |       | 35  | 150   | μV/V   |
|                                          |        | TA = TMIN to TMAX             |       |     | 200   |        |
| Load Regulation                          |        | 0mA < IOUT < 10mA, sink       |       | 120 | 200   | μV/mA  |
|                                          |        | 0mA < IOUT < 10mA, source     |       | 120 | 200   |        |
| Output Current                           | IOUT   |                               | -10   |     | +10   | mA     |
| Short-Circuit Current                    | ISC    | Sourcing to ground            |       | 25  |       | mA     |
|                                          |        | Sinking from VIN              |       | 25  |       |        |
| Long-Term Stability                      |        | 1000 hours at TA = +25°C      |       | 35  |       | ppm    |
| Thermal Hysteresis                       |        | (Note 5)                      |       | 85  |       | ppm    |

**Electrical Characteristics—MAX607\_\_AUT18 ( $V_{OUT} = 1.800V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL           | CONDITIONS                                                                                    |                                        | MIN                   | TYP | MAX                   | UNITS             |
|---------------------------------|------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|-----------------------|-----|-----------------------|-------------------|
| DYNAMIC CHARACTERISTICS         |                  |                                                                                               |                                        |                       |     |                       |                   |
| Noise Voltage                   | e <sub>OUT</sub> | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                            |                                        | 6                     |     |                       | μV <sub>P-P</sub> |
|                                 |                  | MAX6071 thermal noise, 10Hz to 10kHz<br>C <sub>OUT</sub> = 0.1μF                              |                                        | 7                     |     | μV <sub>RMS</sub>     |                   |
|                                 |                  | MAX6070 thermal noise, 10Hz to 10kHz<br>C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |                                        | 5                     |     |                       |                   |
| Ripple Rejection                |                  | Frequency = 60Hz                                                                              |                                        | 89                    |     |                       | dB                |
| Turn-On Settling Time           | t <sub>R</sub>   | Settling to 0.01%<br>C <sub>OUT</sub> = 0.1μF                                                 | MAX6070<br>C <sub>FILTER</sub> = 0.1μF | 6                     |     |                       | ms                |
|                                 |                  |                                                                                               | MAX6071                                | 32                    |     |                       | μs                |
| Enable Settling Time            | t <sub>EN</sub>  | Settling to 0.01%<br>C <sub>OUT</sub> = 0.1μF                                                 | MAX6070<br>C <sub>FILTER</sub> = 0.1μF | 6                     |     |                       | ms                |
|                                 |                  |                                                                                               | MAX6071                                | 60                    |     |                       | μs                |
| Capacitive-Load Stability Range |                  | I <sub>OUT</sub> ≤10mA                                                                        |                                        | 0.1                   |     | 10                    | μF                |
| INPUT                           |                  |                                                                                               |                                        |                       |     |                       |                   |
| Supply Voltage                  | V <sub>IN</sub>  | Guaranteed by line regulation                                                                 |                                        | 2.7                   |     | 5.5                   | V                 |
| Quiescent Supply Current        | I <sub>IN</sub>  | T <sub>A</sub> = +25°C                                                                        |                                        | 130                   |     | 200                   | μA                |
|                                 |                  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>                                         |                                        | 260                   |     |                       |                   |
| Shutdown Supply Current         | I <sub>SD</sub>  |                                                                                               |                                        |                       |     | 6                     | μA                |
| ENABLE                          |                  |                                                                                               |                                        |                       |     |                       |                   |
| Enable Input Current            | I <sub>EN</sub>  |                                                                                               |                                        | -1                    |     | 1                     | μA                |
| Enable Logic-High               | V <sub>IH</sub>  |                                                                                               |                                        | 0.7 x V <sub>IN</sub> |     | 0.3 x V <sub>IN</sub> | V                 |
| Enable Logic-Low                | V <sub>IL</sub>  |                                                                                               |                                        |                       |     |                       |                   |

**Electrical Characteristics—MAX607\_\_AUT21 ( $V_{OUT} = 2.048V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                |                                                       | MIN   | TYP | MAX   | UNITS  |
|-------------------------------------------|--------------------|-------------------------------------------|-------------------------------------------------------|-------|-----|-------|--------|
| OUTPUT                                    |                    |                                           |                                                       |       |     |       |        |
| Output Voltage Accuracy                   |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C |                                                       | -0.04 |     | +0.04 | %      |
|                                           |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C |                                                       | -0.08 |     | +0.08 |        |
| Output Voltage Temperature Drift (Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                         |                                                       |       | 1.5 | 6     | ppm/°C |
|                                           |                    | MAX6070B/MAX6071B                         |                                                       |       | 2.0 | 8     |        |
| Line Regulation                           |                    | Over specified V <sub>IN</sub> range      | T <sub>A</sub> = +25°C                                |       | 50  | 180   | μV/V   |
|                                           |                    |                                           | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |     | 225   |        |

**Electrical Characteristics—MAX607\_\_AUT21 ( $V_{OUT} = 2.048V$ ) (continued)**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL           | CONDITIONS                                                                                    | MIN                                    | TYP | MAX | UNITS             |
|---------------------------------|------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|-----|-----|-------------------|
| Load Regulation                 |                  | 0mA < I <sub>OUT</sub> < 10mA, sink                                                           |                                        | 135 | 225 | μV/mA             |
|                                 |                  | 0mA < I <sub>OUT</sub> < 10mA, source                                                         |                                        | 135 | 225 |                   |
| Output Current                  | I <sub>OUT</sub> |                                                                                               | -10                                    |     | +10 | mA                |
| Short-Circuit Current           | I <sub>SC</sub>  | Sourcing to ground                                                                            |                                        | 25  |     | mA                |
|                                 |                  | Sinking from V <sub>IN</sub>                                                                  |                                        | 25  |     |                   |
| Long-Term Stability             |                  | 1000 hours at T <sub>A</sub> = +25°C                                                          |                                        | 35  |     | ppm               |
| Thermal Hysteresis              |                  | (Note 5)                                                                                      |                                        | 85  |     | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>  |                  |                                                                                               |                                        |     |     |                   |
| Noise Voltage                   | e <sub>OUT</sub> | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                            |                                        | 6.4 |     | μV <sub>P-P</sub> |
|                                 |                  | MAX6071 thermal noise, 10Hz to 10kHz<br>C <sub>OUT</sub> = 0.1μF                              |                                        | 8.6 |     | μV <sub>RMS</sub> |
|                                 |                  | MAX6070 thermal noise, 10Hz to 10kHz<br>C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |                                        | 6.3 |     |                   |
| Ripple Rejection                |                  | Frequency = 60Hz                                                                              |                                        | 86  |     | dB                |
| Turn-On Settling Time           | t <sub>R</sub>   | Settling to 0.01%<br>C <sub>OUT</sub> = 0.1μF                                                 | MAX6070<br>C <sub>FILTER</sub> = 0.1μF | 6.2 |     | ms                |
|                                 |                  |                                                                                               | MAX6071                                | 25  |     | μs                |
| Enable Settling Time            | t <sub>EN</sub>  | Settling to 0.01%<br>C <sub>OUT</sub> = 0.1μF                                                 | MAX6070<br>C <sub>FILTER</sub> = 0.1μF | 6.2 |     | ms                |
|                                 |                  |                                                                                               | MAX6071                                | 65  |     | μs                |
| Capacitive-Load Stability Range |                  | I <sub>OUT</sub> ≤ 10mA                                                                       | 0.1                                    |     | 10  | μF                |
| <b>INPUT</b>                    |                  |                                                                                               |                                        |     |     |                   |
| Supply Voltage                  | V <sub>IN</sub>  | Guaranteed by line regulation                                                                 | 2.7                                    |     | 5.5 | V                 |
| Quiescent Supply Current        | I <sub>IN</sub>  | T <sub>A</sub> = +25°C                                                                        |                                        | 130 | 200 | μA                |
|                                 |                  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>                                         |                                        |     | 260 |                   |
| Shutdown Supply Current         | I <sub>SD</sub>  |                                                                                               |                                        |     | 6   | μA                |
| <b>ENABLE</b>                   |                  |                                                                                               |                                        |     |     |                   |
| Enable Input Current            | I <sub>EN</sub>  |                                                                                               | -1                                     |     | +1  | μA                |
| Enable Logic-High               | V <sub>IH</sub>  |                                                                                               | 0.7 × V <sub>IN</sub>                  |     |     | V                 |
| Enable Logic-Low                | V <sub>IL</sub>  |                                                                                               | 0.3 × V <sub>IN</sub>                  |     |     |                   |

**Electrical Characteristics—MAX607\_\_AUT25 ( $V_{OUT} = 2.500V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                                                                  | MIN   | TYP                                  | MAX   | UNITS             |
|-------------------------------------------|--------------------|---------------------------------------------------------------------------------------------|-------|--------------------------------------|-------|-------------------|
| <b>OUTPUT</b>                             |                    |                                                                                             |       |                                      |       |                   |
| Output Voltage Accuracy                   |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C                                                   | -0.04 |                                      | +0.04 | %                 |
|                                           |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C                                                   | -0.08 |                                      | +0.08 |                   |
| Output Voltage Temperature Drift (Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                                                                           |       | 1.5                                  | 6     | ppm/°C            |
|                                           |                    | MAX6070B/MAX6071B                                                                           |       | 2.0                                  | 8     |                   |
| Line Regulation                           |                    | Over specified V <sub>IN</sub> range                                                        |       | 60                                   | 145   | μV/V              |
|                                           |                    | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>             |       |                                      | 175   |                   |
| Load Regulation                           |                    | 0mA < I <sub>OUT</sub> < 10mA, sink                                                         |       | 80                                   | 140   | μV/mA             |
|                                           |                    | 0mA < I <sub>OUT</sub> < 10mA, source                                                       |       | 75                                   | 125   |                   |
| Dropout Voltage                           |                    | I <sub>OUT</sub> = 10mA, T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 4)     |       | 110                                  | 230   | mV                |
| Output Current                            | I <sub>OUT</sub>   |                                                                                             | -10   |                                      | +10   | mA                |
| Short-Circuit Current                     | I <sub>SC</sub>    | Sourcing to ground                                                                          |       | 25                                   |       | mA                |
|                                           |                    | Sinking from V <sub>IN</sub>                                                                |       | 25                                   |       |                   |
| Long-Term Stability                       |                    | 1000 hours at T <sub>A</sub> = +25°C                                                        |       | 40                                   |       | ppm               |
| Thermal Hysteresis                        |                    | (Note 5)                                                                                    |       | 85                                   |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>            |                    |                                                                                             |       |                                      |       |                   |
| Noise Voltage                             | e <sub>OUT</sub>   | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                          |       | 4.8                                  |       | μV <sub>P-P</sub> |
|                                           |                    | MAX6071 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF                              |       | 6                                    |       | μV <sub>RMS</sub> |
|                                           |                    | MAX6070 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |       | 3                                    |       |                   |
| Noise Spectral Density                    |                    | MAX6071 thermal noise, f = 1kHz, C <sub>OUT</sub> = 0.1μF                                   |       | 60                                   |       | nV/√Hz            |
|                                           |                    | MAX6070 thermal noise, f = 1kHz, C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF      |       | 30                                   |       |                   |
| Ripple Rejection                          |                    | Frequency = 60Hz                                                                            |       | 84                                   |       | dB                |
| Turn-On Settling Time                     | t <sub>R</sub>     | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 |       | MAX6070, C <sub>FILTER</sub> = 0.1μF | 10    | ms                |
|                                           |                    |                                                                                             |       | MAX6071                              | 30    | μs                |
| Enable Settling Time                      | t <sub>EN</sub>    | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 |       | MAX6070, C <sub>FILTER</sub> = 0.1μF | 10    | ms                |
|                                           |                    |                                                                                             |       | MAX6071                              | 75    | μs                |
| Capacitive-Load Stability Range           |                    | I <sub>OUT</sub> ≤ 10mA                                                                     | 0.1   |                                      | 10    | μF                |

**Electrical Characteristics—MAX607\_\_AUT25 ( $V_{OUT} = 2.500V$ ) (continued)**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                | SYMBOL          | CONDITIONS                                            | MIN                   | TYP                   | MAX | UNITS |
|--------------------------|-----------------|-------------------------------------------------------|-----------------------|-----------------------|-----|-------|
| <b>INPUT</b>             |                 |                                                       |                       |                       |     |       |
| Supply Voltage           | V <sub>IN</sub> | Guaranteed by line regulation                         | 2.8                   |                       | 5.5 | V     |
| Quiescent Supply Current | I <sub>IN</sub> | T <sub>A</sub> = +25°C                                |                       | 150                   | 235 | μA    |
|                          |                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                       |                       | 300 |       |
| Shutdown Supply Current  | I <sub>SD</sub> |                                                       |                       | 0.6                   | 6   | μA    |
| <b>ENABLE/SHUTDOWN</b>   |                 |                                                       |                       |                       |     |       |
| Enable Input Current     | I <sub>EN</sub> |                                                       | -1                    |                       | +1  | μA    |
| Enable Logic-High        | V <sub>IH</sub> |                                                       | 0.7 × V <sub>IN</sub> |                       |     | V     |
| Enable Logic-Low         | V <sub>IL</sub> |                                                       |                       | 0.3 × V <sub>IN</sub> |     |       |

**Electrical Characteristics—MAX607\_\_AUT30 ( $V_{OUT} = 3.000V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                                                                  | MIN   | TYP | MAX   | UNITS             |
|-------------------------------------------|--------------------|---------------------------------------------------------------------------------------------|-------|-----|-------|-------------------|
| <b>OUTPUT</b>                             |                    |                                                                                             |       |     |       |                   |
| Output Voltage Accuracy                   |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C                                                   | -0.04 |     | +0.04 | %                 |
|                                           |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C                                                   | -0.08 |     | +0.08 |                   |
| Output Voltage Temperature Drift (Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                                                                           |       | 1.5 | 6     | ppm/°C            |
|                                           |                    | MAX6070B/MAX6071B                                                                           |       | 2.0 | 8     |                   |
| Line Regulation                           |                    | Over specified V <sub>IN</sub> range                                                        |       | 90  | 200   | μV/V              |
|                                           |                    | T <sub>A</sub> = +25°C<br>T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>             |       |     | 260   |                   |
| Load Regulation                           |                    | 0mA < I <sub>OUT</sub> < 10mA, sink                                                         |       | 90  | 170   | μV/mA             |
|                                           |                    | 0mA < I <sub>OUT</sub> < 10mA, source                                                       |       | 90  | 150   |                   |
| Dropout Voltage                           |                    | I <sub>OUT</sub> = 10mA, T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 4)     |       | 80  | 150   | mV                |
| Output Current                            | I <sub>OUT</sub>   |                                                                                             | -10   |     | +10   | mA                |
| Short-Circuit Current                     | I <sub>SC</sub>    | Sourcing to ground                                                                          |       | 25  |       | mA                |
|                                           |                    | Sinking from V <sub>IN</sub>                                                                |       | 25  |       |                   |
| Long-Term Stability                       |                    | 1000 hours at T <sub>A</sub> = +25°C                                                        |       | 40  |       | ppm               |
| Thermal Hysteresis                        |                    | (Note 5)                                                                                    |       | 85  |       | ppm               |
| <b>DYNAMIC CHARACTERISTICS</b>            |                    |                                                                                             |       |     |       |                   |
| Noise Voltage                             | e <sub>OUT</sub>   | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                          |       | 4.6 |       | μV <sub>P-P</sub> |
|                                           |                    | MAX6071 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF                              |       | 7.8 |       | μV <sub>RMS</sub> |
|                                           |                    | MAX6070 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |       | 5.0 |       |                   |
| Ripple Rejection                          |                    | Frequency = 60Hz                                                                            |       | 80  |       | dB                |

**Electrical Characteristics—MAX607\_\_AUT30 ( $V_{OUT} = 3.000V$ ) (continued)**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL          | CONDITIONS                                            | MIN                                     | TYP | MAX | UNITS |
|---------------------------------|-----------------|-------------------------------------------------------|-----------------------------------------|-----|-----|-------|
| Turn-On Settling Time           | t <sub>R</sub>  | Settling to 0.01%,<br>C <sub>OUT</sub> = 0.1μF        | MAX6070,<br>C <sub>FILTER</sub> = 0.1μF |     | 9.7 | ms    |
|                                 |                 |                                                       | MAX6071                                 |     | 40  | μs    |
| Enable Settling Time            | t <sub>EN</sub> | Settling to 0.01%,<br>C <sub>OUT</sub> = 0.1μF        | MAX6070,<br>C <sub>FILTER</sub> = 0.1μF |     | 9.7 | ms    |
|                                 |                 |                                                       | MAX6071                                 |     | 75  | μs    |
| Capacitive-Load Stability Range |                 | I <sub>OUT</sub> ≤ 10mA                               | 0.1                                     |     | 10  | μF    |
| <b>INPUT</b>                    |                 |                                                       |                                         |     |     |       |
| Supply Voltage                  | V <sub>IN</sub> | Guaranteed by line regulation                         | 3.2                                     |     | 5.5 | V     |
| Quiescent Supply Current        | I <sub>IN</sub> | T <sub>A</sub> = +25°C                                |                                         | 150 | 235 | μA    |
|                                 |                 | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |                                         |     | 300 |       |
| Shutdown Supply Current         | I <sub>SD</sub> |                                                       |                                         | 0.6 | 6   | μA    |
| <b>ENABLE/SHUTDOWN</b>          |                 |                                                       |                                         |     |     |       |
| Enable Input Current            | I <sub>EN</sub> |                                                       | -1                                      |     | +1  | μA    |
| Enable Logic-High               | V <sub>IH</sub> |                                                       | 0.7 × V <sub>IN</sub>                   |     |     | V     |
| Enable Logic-Low                | V <sub>IL</sub> |                                                       | 0.3 × V <sub>IN</sub>                   |     |     |       |

**Electrical Characteristics—MAX607\_\_AUT33 ( $V_{OUT} = 3.300V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                    | SYMBOL             | CONDITIONS                                                                                 | MIN   | TYP                                                   | MAX   | UNITS  |
|----------------------------------------------|--------------------|--------------------------------------------------------------------------------------------|-------|-------------------------------------------------------|-------|--------|
| <b>OUTPUT</b>                                |                    |                                                                                            |       |                                                       |       |        |
| Output Voltage Accuracy                      |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C                                                  | -0.04 |                                                       | +0.04 | %      |
|                                              |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C                                                  | -0.08 |                                                       | +0.08 |        |
| Output Voltage Temperature Drift<br>(Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                                                                          |       | 1.5                                                   | 6     | ppm/°C |
|                                              |                    | MAX6070B/MAX6071B                                                                          |       | 2.0                                                   | 8     |        |
| Line Regulation                              |                    | Over specified V <sub>IN</sub><br>range                                                    |       | T <sub>A</sub> = +25°C                                | 90    | μV/V   |
|                                              |                    |                                                                                            |       | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> | 285   |        |
| Load Regulation                              |                    | 0mA < I <sub>OUT</sub> < 10mA, sink                                                        |       | 100                                                   | 190   | μV/mA  |
|                                              |                    | 0mA < I <sub>OUT</sub> < 10mA, source                                                      |       | 100                                                   | 165   |        |
| Dropout Voltage                              |                    | I <sub>OUT</sub> = 10mA, T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub><br>(Note 4) |       | 65                                                    | 150   | mV     |
| Output Current                               | I <sub>OUT</sub>   |                                                                                            | -10   |                                                       | 10    | mA     |
| Short-Circuit Current                        | I <sub>SC</sub>    | Sourcing to ground                                                                         |       | 25                                                    |       | mA     |
|                                              |                    | Sinking from V <sub>IN</sub>                                                               |       | 25                                                    |       |        |
| Long-Term Stability                          |                    | 1000 hours at T <sub>A</sub> = +25°C                                                       |       | 40                                                    |       | ppm    |
| Thermal Hysteresis                           |                    | (Note 5)                                                                                   |       | 85                                                    |       | ppm    |

**Electrical Characteristics—MAX607\_\_AUT33 ( $V_{OUT} = 3.300V$ ) (continued)**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL           | CONDITIONS                                                                                  | MIN                   | TYP                   | MAX | UNITS             |
|---------------------------------|------------------|---------------------------------------------------------------------------------------------|-----------------------|-----------------------|-----|-------------------|
| <b>DYNAMIC CHARACTERISTICS</b>  |                  |                                                                                             |                       |                       |     |                   |
| Noise Voltage                   | e <sub>OUT</sub> | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                          |                       | 10                    |     | μV <sub>P-P</sub> |
|                                 |                  | MAX6071 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF                              |                       | 9                     |     | μV <sub>RMS</sub> |
|                                 |                  | MAX6070 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |                       | 6                     |     |                   |
| Ripple Rejection                |                  | Frequency = 60Hz                                                                            |                       | 78                    |     | dB                |
| Turn-On Settling Time           | t <sub>R</sub>   | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 |                       | 10                    |     | ms                |
|                                 |                  | MAX6071                                                                                     |                       | 42                    |     | μs                |
| Enable Settling Time            | t <sub>EN</sub>  | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 |                       | 10                    |     | ms                |
|                                 |                  | MAX6071                                                                                     |                       | 75                    |     | μs                |
| Capacitive-Load Stability Range |                  | I <sub>OUT</sub> ≤ 10mA                                                                     | 0.1                   |                       | 10  | μF                |
| <b>INPUT</b>                    |                  |                                                                                             |                       |                       |     |                   |
| Supply Voltage                  | V <sub>IN</sub>  | Guaranteed by line regulation                                                               | 3.5                   |                       | 5.5 | V                 |
| Quiescent Supply Current        | I <sub>IN</sub>  | T <sub>A</sub> = +25°C                                                                      |                       | 160                   | 240 | μA                |
|                                 |                  | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>                                       |                       |                       | 330 |                   |
| Shutdown Supply Current         | I <sub>SD</sub>  |                                                                                             |                       | 0.6                   | 6   | μA                |
| <b>ENABLE/SHUTDOWN</b>          |                  |                                                                                             |                       |                       |     |                   |
| Enable Input Current            | I <sub>EN</sub>  |                                                                                             | -1                    |                       | 1   | μA                |
| Enable Logic-High               | V <sub>IH</sub>  |                                                                                             | 0.7 × V <sub>IN</sub> |                       |     | V                 |
| Enable Logic-Low                | V <sub>IL</sub>  |                                                                                             |                       | 0.3 × V <sub>IN</sub> |     |                   |

**Electrical Characteristics—MAX607\_\_AUT41 ( $V_{OUT} = 4.096V$ )**(V<sub>IN</sub> = +5.0V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                            | MIN   | TYP | MAX   | UNITS  |
|-------------------------------------------|--------------------|-------------------------------------------------------|-------|-----|-------|--------|
| <b>OUTPUT</b>                             |                    |                                                       |       |     |       |        |
| Output Voltage Accuracy                   |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C             | -0.04 |     | +0.04 | %      |
|                                           |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C             | -0.08 |     | +0.08 |        |
| Output Voltage Temperature Drift (Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                                     |       | 1.5 | 6     | ppm/°C |
|                                           |                    | MAX6070B/MAX6071B                                     |       | 2.0 | 8     |        |
| Line Regulation                           |                    | Over specified V <sub>IN</sub> range                  |       | 100 | 250   | μV/V   |
|                                           |                    | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |     | 350   |        |

**Electrical Characteristics—MAX607\_\_AUT41 ( $V_{OUT} = 4.096V$ ) (continued)**

(VIN = +5.0V, IOUT = 0mA, COUT = 0.1μF, TA = -40°C to +125°C, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

| PARAMETER                       | SYMBOL | CONDITIONS                                                          | MIN                         | TYP | MAX       | UNITS |
|---------------------------------|--------|---------------------------------------------------------------------|-----------------------------|-----|-----------|-------|
| Load Regulation                 |        | 0mA < IOUT < 10mA, sink                                             |                             | 125 | 225       | μV/mA |
|                                 |        | 0mA < IOUT < 10mA, source                                           |                             | 135 | 225       |       |
| Dropout Voltage                 |        | IOUT = 10mA, TA = TMIN to TMAX (Note 4)                             |                             | 75  | 150       | mV    |
| Output Current                  | IOUT   |                                                                     | -10                         |     | +10       | mA    |
| Short-Circuit Current           | ISC    | Sourcing to ground                                                  |                             | 25  |           | mA    |
|                                 |        | Sinking from VIN                                                    |                             | 25  |           |       |
| Long-Term Stability             |        | 1000 hours at TA = +25°C                                            |                             | 35  |           | ppm   |
| Thermal Hysteresis              |        | (Note 5)                                                            |                             | 85  |           | ppm   |
| <b>DYNAMIC CHARACTERISTICS</b>  |        |                                                                     |                             |     |           |       |
| Noise Voltage                   | eOUT   | 1/f noise, 0.1Hz to 10Hz, COUT = 0.1μF                              |                             | 9.6 |           | μVp-p |
|                                 |        | MAX6071 thermal noise, 10Hz to 10kHz, COUT = 0.1μF                  |                             | 12  |           | μVRMS |
|                                 |        | MAX6070 thermal noise, 10Hz to 10kHz, COUT = 0.1μF, CFILTER = 0.1μF |                             | 9   |           |       |
| Ripple Rejection                |        | Frequency = 60Hz                                                    |                             | 80  |           | dB    |
| Turn-On Settling Time           | tR     | Settling to 0.01%,<br>COUT = 0.1μF                                  | MAX6070,<br>CFILTER = 0.1μF | 10  |           | ms    |
|                                 |        |                                                                     |                             | 40  |           | μs    |
| Enable Settling Time            | tEN    | Settling to 0.01%,<br>COUT = 0.1μF                                  | MAX6070,<br>CFILTER = 0.1μF | 10  |           | ms    |
|                                 |        |                                                                     |                             | 85  |           | μs    |
| Capacitive-Load Stability Range |        | IOUT ≤ 10mA                                                         | 0.1                         |     | 10        | μF    |
| <b>INPUT</b>                    |        |                                                                     |                             |     |           |       |
| Supply Voltage                  | VIN    | Guaranteed by line regulation                                       | 4.3                         |     | 5.5       | V     |
| Quiescent Supply Current        | IIN    | TA = +25°C                                                          |                             | 150 | 235       | μA    |
|                                 |        | TA = TMIN to TMAX                                                   |                             |     | 350       |       |
| Shutdown Supply Current         | ISD    |                                                                     |                             |     | 6         | μA    |
| <b>ENABLE</b>                   |        |                                                                     |                             |     |           |       |
| Enable Input Current            | IEN    |                                                                     | -1                          |     | +1        | μA    |
| Enable Logic-High               | VIH    |                                                                     | 0.7 × VIN                   |     |           | V     |
| Enable Logic-Low                | VIL    |                                                                     |                             |     | 0.3 × VIN |       |

**Electrical Characteristics—MAX607\_\_AUT50 ( $V_{OUT} = 5.000V$ )**(V<sub>IN</sub> = +5.5V, I<sub>OUT</sub> = 0mA, C<sub>OUT</sub> = 0.1μF, T<sub>A</sub> = -40°C to +125°C, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

| PARAMETER                                 | SYMBOL             | CONDITIONS                                                                                  |                                                       | MIN   | TYP | MAX   | UNITS             |
|-------------------------------------------|--------------------|---------------------------------------------------------------------------------------------|-------------------------------------------------------|-------|-----|-------|-------------------|
| OUTPUT                                    |                    |                                                                                             |                                                       |       |     |       |                   |
| Output Voltage Accuracy                   |                    | MAX6070A/MAX6071A, T <sub>A</sub> = +25°C                                                   |                                                       | -0.04 |     | +0.04 | %                 |
|                                           |                    | MAX6070B/MAX6071B, T <sub>A</sub> = +25°C                                                   |                                                       | -0.08 |     | +0.08 |                   |
| Output Voltage Temperature Drift (Note 3) | TCV <sub>OUT</sub> | MAX6070A/MAX6071A                                                                           |                                                       |       | 1.5 | 6     | ppm/°C            |
|                                           |                    | MAX6070B/MAX6071B                                                                           |                                                       |       | 2.0 | 8     |                   |
| Line Regulation                           |                    | Over specified V <sub>IN</sub> range                                                        | T <sub>A</sub> = +25°C                                |       | 200 | 400   | μV/V              |
|                                           |                    |                                                                                             | T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> |       |     | 500   |                   |
| Load Regulation                           |                    | 0mA < I <sub>OUT</sub> < 10mA, sink                                                         |                                                       |       | 160 | 275   | μV/mA             |
|                                           |                    | 0mA < I <sub>OUT</sub> < 10mA, source                                                       |                                                       |       | 160 | 275   |                   |
| Dropout Voltage                           |                    | I <sub>OUT</sub> = 10mA, T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub> (Note 6)     |                                                       |       | 60  | 150   | mV                |
| Output Current                            | I <sub>OUT</sub>   |                                                                                             |                                                       | -10   |     | +10   | mA                |
| Short-Circuit Current                     | I <sub>SC</sub>    | Sourcing to ground                                                                          |                                                       |       | 25  |       | mA                |
|                                           |                    | Sinking from V <sub>IN</sub>                                                                |                                                       |       | 25  |       |                   |
| Long-Term Stability                       |                    | 1000 hours at T <sub>A</sub> = +25°C                                                        |                                                       |       | 35  |       | ppm               |
| Thermal Hysteresis                        |                    | (Note 5)                                                                                    |                                                       |       | 85  |       | ppm               |
| DYNAMIC CHARACTERISTICS                   |                    |                                                                                             |                                                       |       |     |       |                   |
| Noise Voltage                             | e <sub>OUT</sub>   | 1/f noise, 0.1Hz to 10Hz, C <sub>OUT</sub> = 0.1μF                                          |                                                       |       | 9   |       | μV <sub>P-P</sub> |
|                                           |                    | MAX6071 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF                              |                                                       |       | 15  |       | μV <sub>RMS</sub> |
|                                           |                    | MAX6070 thermal noise, 10Hz to 10kHz, C <sub>OUT</sub> = 0.1μF, C <sub>FILTER</sub> = 0.1μF |                                                       |       | 12  |       |                   |
| Ripple Rejection                          |                    | Frequency = 60Hz                                                                            |                                                       |       | 74  |       | dB                |
| Turn-On Settling Time                     | t <sub>R</sub>     | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 | MAX6070, C <sub>FILTER</sub> = 0.1μF                  |       | 10  |       | ms                |
|                                           |                    |                                                                                             | MAX6071                                               |       | 50  |       | μs                |
| Enable Settling Time                      | t <sub>EN</sub>    | Settling to 0.01%, C <sub>OUT</sub> = 0.1μF                                                 | MAX6070, C <sub>FILTER</sub> = 0.1μF                  |       | 10  |       | ms                |
|                                           |                    |                                                                                             | MAX6071                                               |       | 100 |       | μs                |
| Capacitive-Load Stability Range           |                    | I <sub>OUT</sub> ≤ 10mA                                                                     |                                                       | 0.1   |     | 10    | μF                |

**Electrical Characteristics—MAX607\_\_AUT50 ( $V_{OUT} = 5.000V$ ) (continued)**

( $V_{IN} = +5.5V$ ,  $I_{OUT} = 0mA$ ,  $C_{OUT} = 0.1\mu F$ ,  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ , unless otherwise noted. Typical values are at  $T_A = +25^{\circ}C$ .) (Note 2)

| PARAMETER                | SYMBOL   | CONDITIONS                    | MIN                 | TYP | MAX | UNITS   |
|--------------------------|----------|-------------------------------|---------------------|-----|-----|---------|
| <b>INPUT</b>             |          |                               |                     |     |     |         |
| Supply Voltage           | $V_{IN}$ | Guaranteed by line regulation | 5.2                 |     | 5.5 | V       |
| Quiescent Supply Current | $I_{IN}$ | $T_A = +25^{\circ}C$          |                     | 160 | 250 | $\mu A$ |
|                          |          | $T_A = T_{MIN}$ to $T_{MAX}$  |                     |     | 330 |         |
| Shutdown Supply Current  | $I_{SD}$ |                               |                     |     | 6   | $\mu A$ |
| <b>ENABLE</b>            |          |                               |                     |     |     |         |
| Enable Input Current     | $I_{EN}$ |                               | -1                  |     | +1  | $\mu A$ |
| Enable Logic-High        | $V_{IH}$ |                               | $0.7 \times V_{IN}$ |     |     | V       |
| Enable Logic-Low         | $V_{IL}$ |                               | $0.3 \times V_{IN}$ |     |     |         |

**Note 2:** Limits are 100% production tested at  $T_A = +25^{\circ}C$ . Specifications where  $T_A < +25^{\circ}C$  or  $T_A > +25^{\circ}C$  are guaranteed by design and characterization.

**Note 3:** Temperature coefficient is calculated using the "box method" which measures temperature drift as the maximum voltage variation over a specified temperature range. The unit of measurement is ppm/ $^{\circ}C$ .

**Note 4:** Dropout voltage is defined as the minimum differential voltage ( $V_{IN} - V_{OUT}$ ) at which  $V_{OUT}$  decreases by 0.2% from its original value at  $V_{IN} = 5.0V$ .

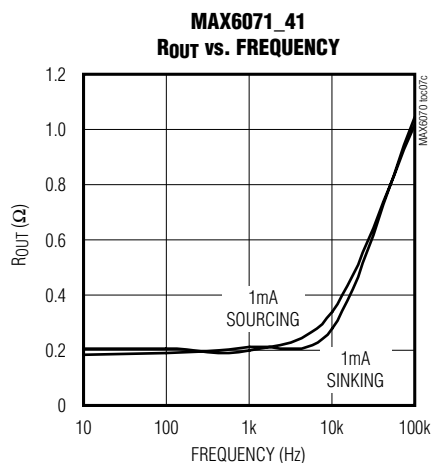
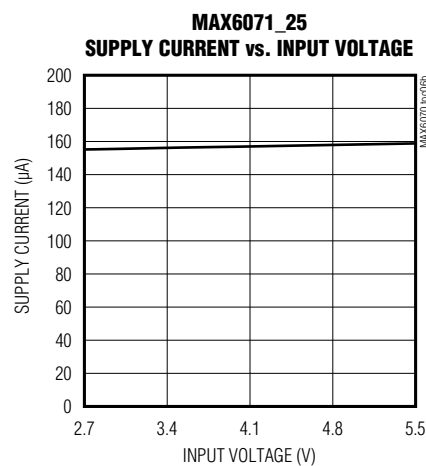
**Note 5:** Thermal hysteresis is defined as the change in  $+25^{\circ}C$  output voltage before and after cycling the device from  $T_{MAX}$  to  $T_{MIN}$ .

**Note 6:** Dropout voltage is defined as the minimum differential voltage ( $V_{IN} - V_{OUT}$ ) at which  $V_{OUT}$  decreases by 0.2% from its original value at  $V_{IN} = 5.5V$ .

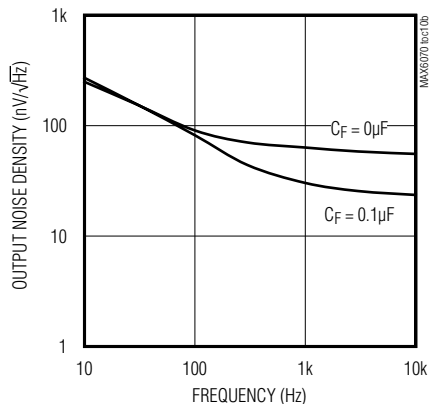
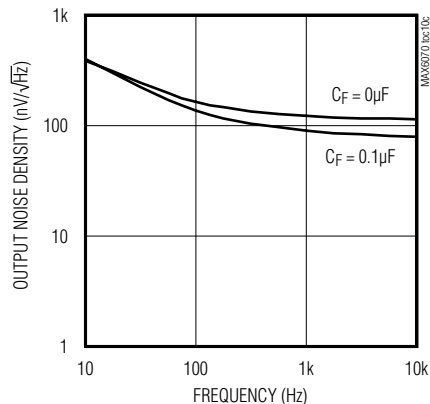
## Typical Operating Characteristics

(T<sub>A</sub> = +25°C, unless otherwise noted.)

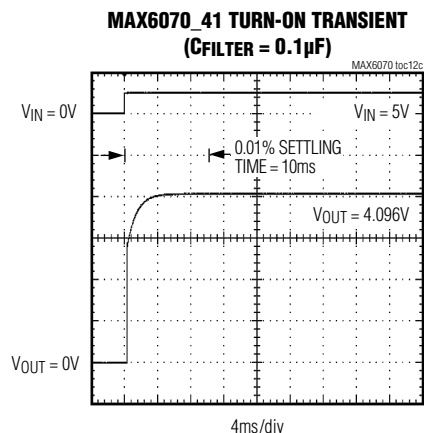
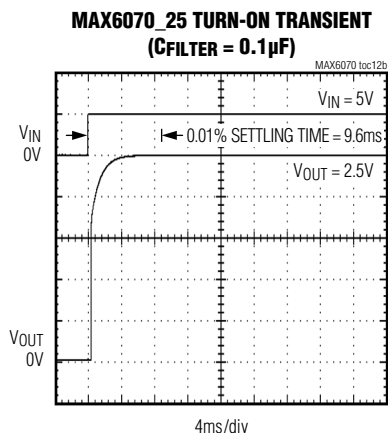
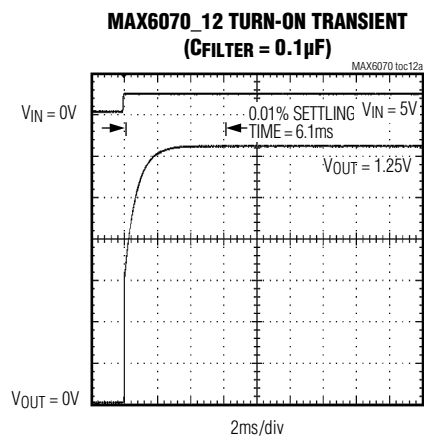
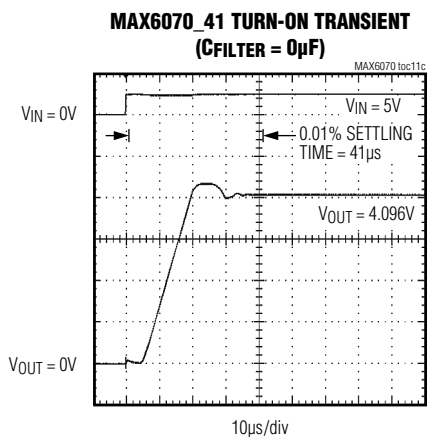
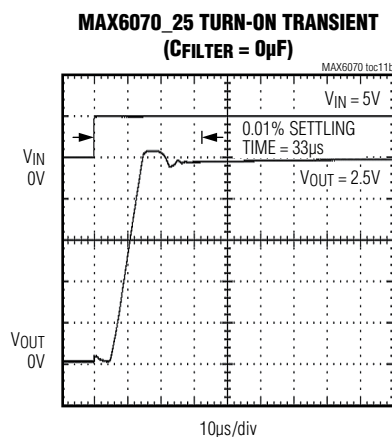
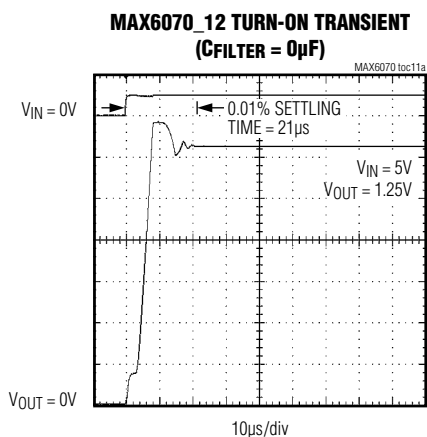
## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)

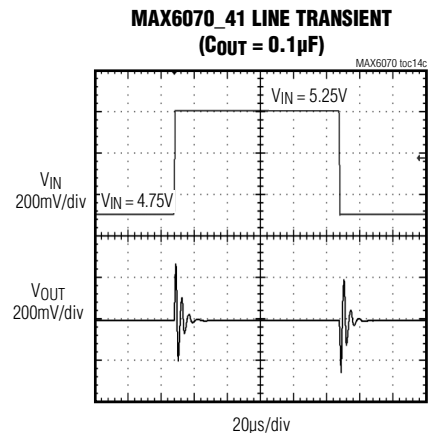
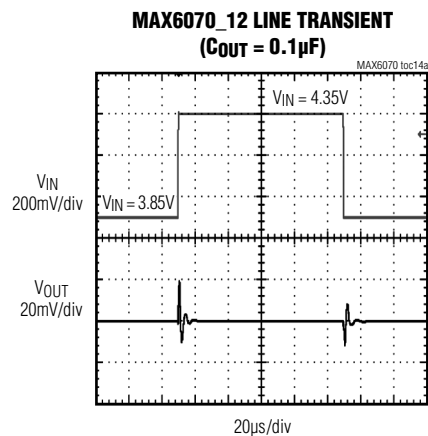
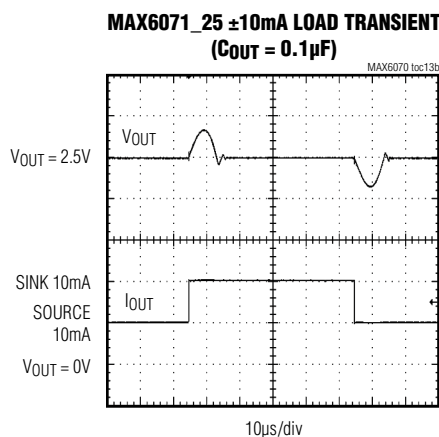
## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)**MAX6071\_25  
SUPPLY CURRENT vs. TEMPERATURE****MAX6071\_41  
SUPPLY CURRENT vs. TEMPERATURE****MAX6070\_12 OUTPUT NOISE  
(0.1Hz TO 10Hz)****MAX6070\_25 OUTPUT NOISE  
(0.1Hz To 10Hz) (SOT23)****MAX6070\_41 OUTPUT NOISE  
(0.1Hz TO 10Hz)****MAX6070\_12  
OUTPUT NOISE DENSITY vs. FREQUENCY****MAX6070\_25  
OUTPUT NOISE DENSITY vs. FREQUENCY****MAX6070\_41  
OUTPUT NOISE DENSITY vs. FREQUENCY**

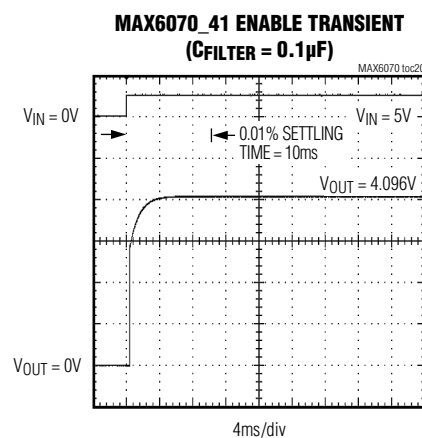
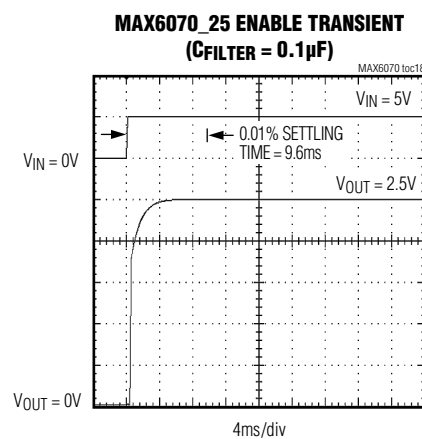
## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)

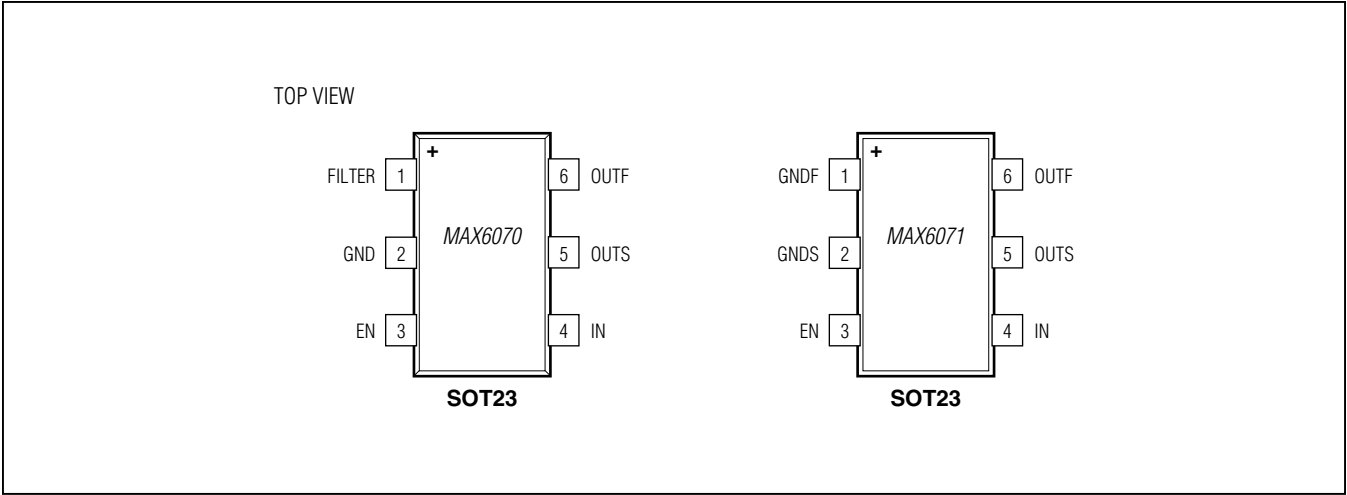
## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)

## Typical Operating Characteristics (continued)

(T<sub>A</sub> = +25°C, unless otherwise noted.)

Pin Configurations



Pin Description

| PIN     |         | NAME   | FUNCTION                                                                                                                                  |
|---------|---------|--------|-------------------------------------------------------------------------------------------------------------------------------------------|
| MAX6070 | MAX6071 |        |                                                                                                                                           |
| 1       | —       | FILTER | Filter Input. Connect a 0.1μF capacitor from FILTER to ground to provide high-frequency bypass. Leave unconnected, if not used.           |
| —       | 1       | GNDF   | Ground Force                                                                                                                              |
| 2       | —       | GND    | Ground                                                                                                                                    |
| -       | 2       | GNDS   | Ground Sense. Connect to ground connection at the load.                                                                                   |
| 3       | 3       | EN     | Enable. Drive high to enable the device. Drive low to disable the device.                                                                 |
| 4       | 4       | IN     | Supply Input                                                                                                                              |
| 5       | 5       | OUTS   | Voltage Reference Sense Output                                                                                                            |
| 6       | 6       | OUTF   | Voltage Reference Force Output. Short OUTF to OUTS as close as possible to the load. Bypass OUTF with a capacitor (0.1μF to 10μF) to GND. |

## Detailed Description

### Wideband Noise Reduction (FILTER)

To improve wideband noise and transient power-supply noise with the MAX6070, connect a  $0.1\mu\text{F}$  capacitor from FILTER to GND (see the [Typical Operating Characteristics](#)). Larger values do not appreciably improve noise reduction. A  $0.1\mu\text{F}$  capacitor reduces the spectral noise density at 1kHz from  $60\text{nV}/\sqrt{\text{Hz}}$  to  $30\text{nV}/\sqrt{\text{Hz}}$  for the 2.5V output. Noise at the input pin can affect output noise, but can be reduced by connecting an optional bypass capacitor between IN and GND as shown in [Figure 1](#).

### Output Bypassing

The MAX6070/MAX6071 require an output capacitor between  $0.1\mu\text{F}$  and  $10\mu\text{F}$ . Place the output capacitor as close to OUTF as possible. For applications driving switching capacitive loads or rapidly changing load currents, use a  $0.1\mu\text{F}$  capacitor in parallel with a larger load capacitor to reduce equivalent series resistance (ESR). Larger capacitor values and lower ESR reduce transients on the reference output.

### Supply Current

The MAX6070/MAX6071 draw  $150\mu\text{A}$  of current and are virtually independent of the supply voltage, with only a  $1.6\mu\text{A}/\text{V}$  variation with supply voltage.

### Thermal Hysteresis

Thermal hysteresis is the change of output voltage at  $T_A = +25^\circ\text{C}$  before and after the device is cycled over its entire operating temperature range. The typical thermal hysteresis value is 85ppm.

### Turn-On Time

These devices typically turn on and settle to within 0.01% of their final value in  $30\mu\text{s}$ . A noise reduction capacitor of  $0.1\mu\text{F}$  increases the turn-on time of the MAX6070 to 10ms.

### Output Force and Sense

The MAX6070/MAX6071 provide independent connections for the force output (OUTF) supplying current to the load and the circuit input regulating the load voltage via the output sense pin (OUTS). This configuration allows for the cancellation of the voltage drop on the lines connecting the MAX6070/MAX6071 and the load. When using the Kelvin connection made possible by the independent force and sense outputs, connect OUTF to the load and

connect OUTS to OUTF at the point where the voltage accuracy is needed (see [Figure 1](#)). The MAX6071 features the same type of Kelvin connection to cancel drops in the ground return line. Connect the load to ground and connect GNDS to ground as close as possible to the load ground connection (see [Figure 2](#)).

### Shutdown

The MAX6070/MAX6071 feature an active-high enable pin (EN). Pulling EN low disables the output with a resistive load to ground and forces the quiescent current to less than  $1\mu\text{A}$ . The value of the load is typically  $200\text{k}\Omega$ . Pulling EN high enables normal operation.

## Applications Information

### Wideband Noise Reduction

[Figure 1](#) shows a typical noise reduction filter application circuit. Note that the use of the wideband noise filter will increase turn-on time.

### High-Resolution DAC and Reference from a Single Supply

[Figure 2](#) shows a typical circuit providing the reference for a high-resolution, 16-bit MAX541 DAC.

### Precision Current Source

[Figure 3](#) shows a typical circuit providing a precision current source. The OUTF output provides the bias current for the bipolar transistor. OUTS and GNDS sense the voltage across the resistor and adjust the current sourced by OUTF accordingly.



Figure 1. Reference Output Kelvin Connection



Figure 2. Reference Ground Kelvin Connection



Figure 3. Precision Current Source

## Selector Guide

| PART              | FILTER | V <sub>OUT</sub> (V) | ACCURACY (%) | TOP MARK |
|-------------------|--------|----------------------|--------------|----------|
| MAX6070AAUT12+T   | Yes    | 1.25                 | 0.04         | +ACPF    |
| MAX6070AAUT18+T   | Yes    | 1.8                  | 0.04         | +ACPH    |
| MAX6070AAUT21+T   | Yes    | 2.048                | 0.04         | +ACPJ    |
| MAX6070AAUT25+T   | Yes    | 2.5                  | 0.04         | +ACPL    |
| MAX6070AAUT30+T   | Yes    | 3.0                  | 0.04         | +ACPN    |
| MAX6070AAUT33+T   | Yes    | 3.3                  | 0.04         | +ACPP    |
| MAX6070AAUT41+T   | Yes    | 4.096                | 0.04         | +ACPR    |
| MAX6070AAUT50+T   | Yes    | 5.0                  | 0.04         | +ACPV    |
| MAX6070AAUT50/V+T | Yes    | 5.0                  | 0.04         | +ACTR    |
| MAX6070BAUT12+T   | Yes    | 1.25                 | 0.08         | +ACPG    |
| MAX6070BAUT12/V+T | Yes    | 1.25                 | 0.08         | +ACSP    |
| MAX6070BAUT18+T   | Yes    | 1.8                  | 0.08         | +ACPI    |
| MAX6070BAUT21+T   | Yes    | 2.048                | 0.08         | +ACPK    |
| MAX6070BAUT25+T   | Yes    | 2.5                  | 0.08         | +ACPM    |
| MAX6070BAUT25/V+T | Yes    | 2.5                  | 0.08         | +ACTS    |
| MAX6070BAUT30+T   | Yes    | 3.0                  | 0.08         | +ACPO    |
| MAX6070BAUT33+T   | Yes    | 3.3                  | 0.08         | +ACPQ    |
| MAX6070BAUT41+T   | Yes    | 4.096                | 0.08         | +ACPS    |
| MAX6070BAUT41/V+T | Yes    | 4.1                  | 0.08         | +ACTT    |
| MAX6070BAUT50+T   | Yes    | 5.0                  | 0.08         | +ACPW    |
| MAX6071AAUT12+T   | No     | 1.25                 | 0.04         | +ACPX    |

/V denotes an automotive qualified part.

+Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

## Selector Guide (continued)

| PART              | FILTER | V <sub>OUT</sub> (V) | ACCURACY (%) | TOP MARK |
|-------------------|--------|----------------------|--------------|----------|
| MAX6071AAUT18+T   | No     | 1.8                  | 0.04         | +ACPZ    |
| MAX6071AAUT21+T   | No     | 2.048                | 0.04         | +ACQB    |
| MAX6071AAUT25+T   | No     | 2.5                  | 0.04         | +ACQD    |
| MAX6071AAUT30+T   | No     | 3.0                  | 0.04         | +ACQF    |
| MAX6071AAUT33+T   | No     | 3.3                  | 0.04         | +ACQH    |
| MAX6071AAUT41+T   | No     | 4.096                | 0.04         | +ACQJ    |
| MAX6071AAUT50+T   | No     | 5.0                  | 0.04         | +ACQN    |
| MAX6071BAUT12+T   | No     | 1.25                 | 0.08         | +ACPY    |
| MAX6071BAUT18+T   | No     | 1.8                  | 0.08         | +ACQA    |
| MAX6071BAUT21+T   | No     | 2.048                | 0.08         | +ACQC    |
| MAX6071BAUT25+T   | No     | 2.5                  | 0.08         | +ACQE    |
| MAX6071BAUT25/V+T | No     | 2.5                  | 0.08         | +ACTU    |
| MAX6071BAUT30+T   | No     | 3.0                  | 0.08         | +ACQG    |
| MAX6071BAUT33+T   | No     | 3.3                  | 0.08         | +ACQI    |
| MAX6071BAUT41+T   | No     | 4.096                | 0.08         | +ACQK    |
| MAX6071BAUT41/V+T | No     | 4.1                  | 0.08         | +ACTV    |
| MAX6071BAUT50+T   | No     | 5.0                  | 0.08         | +ACQO    |
| MAX6071BAUT50/V+T | No     | 5.0                  | 0.08         | +ACTW    |

## Ordering Information

| PART            | TEMP RANGE      | PIN-PACKAGE |
|-----------------|-----------------|-------------|
| MAX6070_AUT_+_T | -40°C to +125°C | 6 SOT23     |
| MAX6071_AUT_+_T | -40°C to +125°C | 6 SOT23     |

+Denotes a lead(Pb)-free/RoHS-compliant package.

T = Tape and reel.

**Note:** The MAX6070/MAX6071 are available in A or B grade with various output voltages. Choose the desired grade and output voltage from the Selector Guide and insert the suffix in the blank above to complete the part number.

## Package Information

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

| PACKAGE TYPE | PACKAGE CODE | DOCUMENT NO.            | LAND PATTERN NO.        |
|--------------|--------------|-------------------------|-------------------------|
| SOT23-6      | U6+5         | <a href="#">21-0058</a> | <a href="#">90-0175</a> |

## Chip Information

PROCESS: BIPOLAR

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION                                                                                                                                                                                                               | PAGES CHANGED   |
|-----------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 0               | 10/12         | Initial release                                                                                                                                                                                                           | —               |
| 1               | 1/13          | Added 2.048V, 3.0V, and 5.0V options to data sheet. Revised <i>General Description</i> , <i>Benefits and Features</i> , <i>Absolute Maximum Ratings</i> , <i>Electrical Characteristics</i> , and <i>Selector Guide</i> . | 1–9, 17, 18     |
| 2               | 3/13          | Added 1.8V and 3.3V options to data sheet. Revised <i>General Description</i> , <i>Benefits and Features</i> , <i>Electrical Characteristics</i> , and <i>Selector Guide</i> .                                            | 1, 2–12, 21, 22 |
| 3               | 2/14          | Added automotive package for the MAX6070B.                                                                                                                                                                                | 21              |
| 4               | 7/15          | Added automotive packages to data sheet and revised TOC9b. Revised <i>Benefits and Features</i> section.                                                                                                                  | 1, 16, 22, 23   |

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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